

07-014

## CURRENT APPLICATION OF ARTIFICIAL INTELLIGENCE TOOL CHAT GPT TO THE DEVELOPMENT OF ENGINEERING PROJECTS

Armero Martínez, Antonio <sup>(1)</sup>; Capuz Rizo, Salvador <sup>(1)</sup>; Hernández Orallo, Enrique <sup>(1)</sup>

<sup>(1)</sup> Universitat Politècnica de Valencia

Artificial intelligence applications of the limited memory type are currently becoming popular. They are applications that can learn because they store information and use it later to solve problems. These apps have a good grasp of language and can demonstrate not only in English. One of the best known in Chat GPT developed by the Open AI company but there are other alternatives. They are tools capable of processing the information they have available to resolve a question raised by the user using a natural language. The problems they solve are from different fields according to the requests of the users. The objective of this work is to verify the utility of Chat GPT in supporting the development of engineering projects. Therefore, it is convenient to check its capacity for drafting documents and for providing support in regulations, calculation formulas, and equipment selection. Also, it should have sufficient accuracy to save time in the development of projects. We will further develop these ideas throughout the article.

*Keywords:* AI; Artificial Intelligence; Chat GPT; engineering projects

## APLICACIÓN ACTUAL DE LA HERRAMIENTA DE INTELIGENCIA ARTIFICIAL CHAT GPT AL DESARROLLO DE PROYECTOS DE INGENIERÍA

Actualmente se están popularizando las aplicaciones de inteligencia artificial del tipo memoria limitada. Son aplicaciones que pueden aprender porque guardan información y la utilizan posteriormente para resolver problemas. Estas aplicaciones tienen un buen manejo del lenguaje y lo demuestran en varios idiomas. Una de las más conocidas en Chat GPT desarrollada por la empresa Open AI pero hay otras alternativas. Son herramientas capaces de procesar la información de la que disponen para resolver una duda planteada por el usuario utilizando un lenguaje natural. Los problemas que resuelven son de diferentes campos según las peticiones de los usuarios. El objetivo del trabajo consiste en comprobar la utilidad de Chat GPT para apoyar el desarrollo de proyectos de ingeniería. Por ello conviene comprobar su capacidad de redacción de documentos y de apoyo en normativa, fórmulas de cálculo y selección de equipos. También con la suficiente precisión que permita ahorrar tiempo en el desarrollo de proyectos. Desarrollaremos estas ideas a lo largo del artículo.

*Palabras clave:* IA, Inteligencia Artificial ; Chat GPT ; proyectos de ingeniería

Agradecimientos: A Salvador Capuz Rizo por su infinita paciencia.



© 2023 by the authors. Licensee AEIPRO, Spain. This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Artificial intelligence (AI) is transforming the way we live and work. From virtual assistants to predictive analytics, AI has the potential to revolutionize many industries and services. It also has become a driving force for innovation in various fields, including engineering. Engineers worldwide are leveraging AI tools to enhance their capabilities, improve efficiency, and address diverse challenges. One of the most promising and groundbreaking AI applications is ChatGPT, a large language model trained by OpenAI based on the GPT-4 architecture. ChatGPT is a Natural Language Processing (NLP) model that can understand and generate human-like language. As a general-purpose tool, engineers can use ChatGPT to analyze and process large amounts of text data, generate solutions to complex problems, and make predictions about future trends. ChatGPT can also serve as a virtual assistant to engineers, providing guidance and automating routine tasks.

One of the major competitors of ChatGPT is IBM's Watson, which is a question-answering computer system capable of analyzing and processing large amounts of unstructured data. Watson has been used in a variety of industries, including healthcare, finance, and engineering, to provide insights and recommendations based on data analysis. Nevertheless, this race has just started, and ChatGPT is the first of a plethora of AI tools that will appear in the short future.

Google has also provided several AI tools, such as BERT (Bidirectional Encoder Representations from Transformers), a more limited Natural Language Processing AI tool compared to ChatGPT, and TensorFlow, an open-source machine learning framework used for various tasks, including natural language processing, image recognition, and predictive analytics. Engineers can use TensorFlow to develop and deploy AI models for a range of applications.

In comparison to these systems, ChatGPT has unique advantages, such as generating human-like responses to text-based inputs, which can be especially useful in virtual assistance and customer service applications. Furthermore, ChatGPT is a pre-trained language model, which means it can be fine-tuned on specific datasets to improve its performance on particular tasks.

In summary, all three are powerful AI tools but are designed for different applications. GPT models like ChatGPT are great for generating creative, human-like text; IBM Watson excels in enterprise-level AI applications requiring specific tasks and structured responses; and BERT shines in understanding the context of language, particularly in search queries.

In this article, we will explore the capabilities of ChatGPT and how it can help engineers in their work. We will discuss how ChatGPT can be used for natural language processing, problem solving, virtual assistance, and knowledge management. We will also examine a real-world example of how engineers can use ChatGPT to improve their engineering processes and outcomes.

By understanding the capabilities of ChatGPT, engineers can take advantage of this powerful tool to enhance their work and increase productivity. Whether you are a mechanical engineer designing new products, a civil engineer optimizing infrastructure, or an electrical engineer managing complex systems, ChatGPT has the potential to transform the way you work and achieve better results. In Spain, engineers, particularly industrial engineers, are known for their

generalist approach, which allows them to adapt to a wide range of engineering fields and applications. This versatility makes the adoption of AI tools especially valuable in enhancing their capabilities, improving efficiency, and addressing complex challenges.

Ultimately, the choice of AI system will depend on the specific needs and requirements of each engineering application. Engineers should consider the strengths and weaknesses of each system and choose the one that is best suited for their particular use case.

## 2. Chat GPT: A Brief History and Recent Achievements

Artificial Intelligence has a rich history dating back to the mid-20th century, with early ideas and research on topics such as machine learning, natural language processing, and problem-solving algorithms. Over the years, AI has evolved significantly, thanks to continuous advancements in computer processing power, data storage, and algorithm development.

In the past decade, AI has experienced a surge in growth and popularity, driven primarily by the success of deep learning algorithms (Goodfellow et al., 2016). Deep learning, a subfield of machine learning, employs artificial neural networks to process and learn from large amounts of data. Some recent achievements in AI that have garnered significant attention include:

- **Image Recognition:** Deep learning has enabled AI models to surpass human performance in various image recognition tasks, such as object detection and classification. This has paved the way for AI applications in areas like computer vision, autonomous vehicles, and medical imaging.
- **Natural Language Processing (NLP):** AI models have demonstrated remarkable improvements in understanding and generating human language. These advancements have led to the creation of sophisticated chatbots, automatic translation services, and advanced text analysis tools.
- **Game Playing:** AI systems have defeated world champions in complex games like Go, chess, and poker. These achievements showcase the potential of AI to solve complex problems and make strategic decisions in real-world applications.
- **Robotics:** AI-driven robots have become increasingly sophisticated, with improved perception, manipulation, and decision-making capabilities. This has led to the development of autonomous systems that can work collaboratively with humans in various domains, from industrial settings to healthcare.

These achievements, among others, have established AI as a transformative technology with the potential to revolutionize numerous industries, including engineering (Schwab, 2017). In the following sections, we will explore specifically the applications of Chat GPT in the engineering field, with a particular focus on the opportunities and challenges faced by industrial engineers. This section highlights some key milestones and achievements in the development of AI technologies that have shaped the current state of the field.

### 2.1 The Rise of AI Assistants and Chatbots

2016: Google Assistant is launched, an AI-powered virtual assistant that uses natural language processing and machine learning to interact with users and provide personalized assistance.

Another significant milestone in AI development is the introduction of the Transformer architecture by Vaswani et al. in 2017. This novel approach to AI processing has since

become the foundation for many state-of-the-art models, including GPT-3 and GPT-4, which have greatly impacted the field of AI engineering.

2019: OpenAI releases the first version of ChatGPT, a conversational AI system designed to generate human-like responses in text-based applications.

2021: AI chatbots and virtual assistants become increasingly integrated into various industries, including customer service, healthcare, and finance, demonstrating the growing potential of AI for diverse applications (Xu et al., 2017).

These milestones and achievements demonstrate the rapid evolution of natural language technologies, which now offer numerous opportunities for application across various industries, including engineering. These milestones in AI development have contributed to the growth and success of AI tools and techniques. The engineering field can greatly benefit from the integration of AI technologies to streamline processes, optimize designs, and enhance overall efficiency (Bughin et al., 2017).

### **3. AI systems for engineering**

As engineers, we are constantly seeking innovative solutions to complex problems. In recent years, AI systems have become increasingly popular as a tool to support the development of engineering projects. However, with so many different AI systems available, it can be challenging to determine which system is right for your needs. In this section, we will discuss some of the most popular AI systems for engineering, including their strengths and weaknesses.

ChatGPT is an AI language model developed by OpenAI that can generate natural language responses to a wide range of questions and prompts. It can be particularly useful for engineers because it can help them quickly generate ideas, solutions, and recommendations for complex engineering problems. ChatGPT can also learn from previous interactions and adapt its responses accordingly. However, it's important to note that ChatGPT is not perfect, and its responses may not always be accurate or appropriate. One potential weakness of ChatGPT is that it relies on large amounts of training data to generate accurate responses. This means that if the training data is biased or incomplete, ChatGPT may generate inaccurate or misleading responses. Additionally, ChatGPT may struggle with complex technical terminology or jargon that is specific to a particular industry or field. Despite these potential weaknesses, ChatGPT can be a valuable tool for engineers looking to quickly generate ideas and solutions to complex problems. By supplementing their own knowledge and expertise with ChatGPT's language generation capabilities, engineers can save time and improve the quality of their work.

IBM Watson is an AI platform that offers a variety of services, including natural language processing, machine learning, and data analytics. It is designed to help businesses and organizations make better decisions and gain insights from large amounts of data. In the engineering context, IBM Watson can be used to analyze sensor data, optimize supply chains, and predict equipment failures. One of the strengths of IBM Watson is its ability to handle large amounts of structured and unstructured data. This makes it a powerful tool for engineers looking to extract insights and make decisions based on data-driven analysis. Additionally, IBM Watson offers a wide range of APIs and development tools that allow engineers to build custom AI applications that meet their specific needs. However, one potential weakness of IBM Watson is its cost. Implementing and using IBM Watson can be expensive, particularly for

small engineering firms or individual engineers. Additionally, IBM Watson may require specialized expertise to use effectively, which can further increase the cost of implementation.

TensorFlow is an open-source software library developed by Google that is designed for machine learning and deep neural networks. It is widely used in engineering applications, such as image recognition, speech recognition, and natural language processing. TensorFlow has the advantage of being highly customizable and flexible, allowing engineers to create their own models and algorithms. One of the strengths of TensorFlow is its ability to handle large and complex datasets (Abadi et al., 2016). This makes it a valuable tool for engineers working with large amounts of data in fields such as machine learning, computer vision, and natural language processing. Additionally, TensorFlow offers a wide range of development tools and resources, including pre-trained models, tutorials, and community support. However, one potential weakness of TensorFlow is that it can be complex and time-consuming to set up and configure. Additionally, engineers may require specialized expertise to effectively use TensorFlow for their specific needs. Google also introduced its own Natural Language Processing tool: BERT (**Bidirectional Encoder Representations from Transformers**) in 2018 which had been completely surpassed by ChatGPT performance (Devlin et al., 2018).

GitHub Copilot X. ChatGPT capabilities to generate programming code from text specifications are awesome. Github, based on the same GPT engine that ChatGPT and trained from billions of lines of code of their GitHub code repository provides a solution for helping programmers to complete code and develop entire functions in real time. This can be seen as one of the first GPT tools oriented specifically to help engineers. Several companies have announced the use of GPT to provide tools to help engineers in CAD design (for example generating drawings using natural language or even interpreting real ones).

In contrast to ChatGPT, traditional rule-based systems rely on predefined rules and decision trees to make predictions and recommendations. These systems can be effective in narrowly-defined applications, but may struggle when faced with complex and ambiguous problems. Additionally, rule-based systems often require significant manual effort to develop and maintain their rule sets.

Overall, ChatGPT is a highly versatile AI system that can provide valuable support to engineers in a wide range of tasks. While there are other AI systems available, ChatGPT's ability to understand natural language and generate human-like responses makes it a powerful tool for communication and collaboration between engineers and other stakeholders.

#### 4. Applications of Chat GPT in engineering

In this section, we will discuss various AI applications that are particularly relevant to the engineers. A significant part of engineering work involves writing technical documents, creating drawings, making measurements, and developing budgets. In this context, it's essential to highlight how artificial intelligence (AI) can assist engineers in these tasks. In the case of language models as ChatGPT, Engineers can benefit from using ChatGPT for writing technical documents, especially when English is not their first language. ChatGPT can help with various aspects of technical writing, such as:

- Grammar and spelling: ChatGPT can help ensure that your writing is grammatically correct and free of spelling errors, improving the overall quality and readability of documents.
- Vocabulary and terminology: ChatGPT can assist in using appropriate technical vocabulary and terminology, making documents more precise and professional.

- Writing style: ChatGPT can help to adapt writing style to be more concise and clearer, which is essential for effective technical communication.
- Formatting and organization: ChatGPT can provide suggestions for organizing content and formatting your documents to enhance clarity and readability.
- Proofreading and editing: Engineers can use ChatGPT as an additional tool for proofreading and editing documents, identifying potential issues, and suggesting improvements.

ChatGPT is accessible to most people and there are some engineering fields where it can be very useful:

- Natural Language Processing: One of the key strengths of ChatGPT is its ability to understand natural language. This means that engineers can use it to analyze and process large amounts of text data, such as customer feedback, technical documentation, and online forums. ChatGPT can also be used to generate summaries of lengthy documents or reports, saving engineers time and effort.
- Problem Solving: ChatGPT can be used to help engineers solve problems by generating suggestions and recommendations based on the data provided. For example, engineers can input data from sensors or other monitoring equipment and receive recommendations on how to optimize a process or system. ChatGPT can also be used to generate solutions to complex problems that may be difficult for humans to solve.
- Predictive Analytics: ChatGPT can be trained on historical data to make predictions about future events or trends. This can be useful for engineers who need to anticipate changes in demand, identify potential risks, or optimize operations. By using ChatGPT to generate predictive models, engineers can make more informed decisions and take proactive measures to prevent problems before they occur. By processing vast amounts of data, AI tools can assist engineers in making data-driven decisions (Morosan, 2016).
- Virtual Assistance: ChatGPT can serve as a virtual assistant to engineers, answering questions, providing guidance, and automating routine tasks. For example, engineers can ask ChatGPT to provide information on a specific topic or to perform a calculation. ChatGPT can also be used to monitor systems and alert engineers when a problem arises.
- Knowledge Management: ChatGPT can be used to capture and store knowledge within an organization. By training ChatGPT on internal documentation, engineers can access information quickly and easily. ChatGPT can also be used to create knowledge graphs, which can help engineers visualize complex relationships and dependencies.

## **5. Case study: AI-Driven Optimization of HVAC and Ventilation Installations for a Clothing Store in the UK**

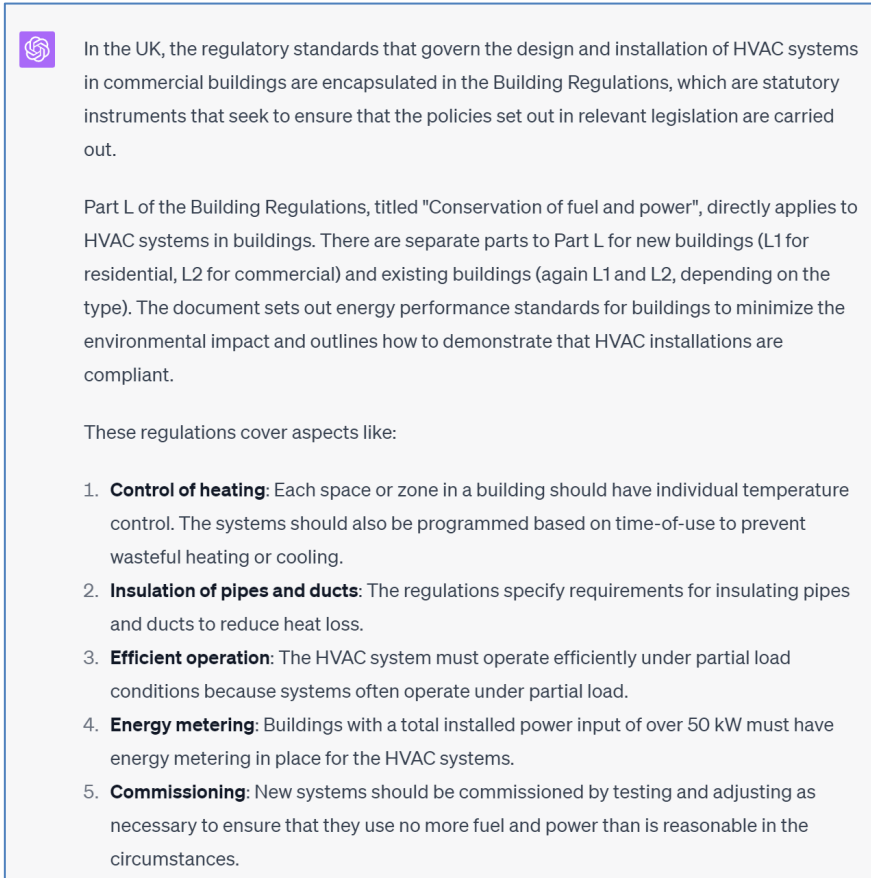
This case study focuses on the application of AI tools, such as ChatGPT, in the design and optimization of HVAC and ventilation installations for a 905,70 m<sup>2</sup> net area clothing store in Dudley, UK. The project showcases the benefits of AI in streamlining calculations, ensuring compliance with British standards, and enhancing the overall efficiency of the installations (British Standards, 2017).

### **5.1 Project Overview**


A team of three industrial engineers was tasked with designing and optimizing HVAC and ventilation installations for a new clothing store. The main objectives were to ensure energy

efficiency, cost-effectiveness, and compliance with British standards, while providing a comfortable shopping environment. The engineers decided to employ AI-driven tools and techniques, like ChatGPT, to streamline the design process and ensure adherence to relevant regulations.

**Figure 1. Example of assistance in applied regulations. Answer by ChatGPT-4.**



The image shows a screenshot of a ChatGPT-4 response. It begins with the OpenAI logo and a paragraph explaining that in the UK, regulatory standards for HVAC systems in commercial buildings are found in the Building Regulations, which are statutory instruments. It then discusses Part L, titled "Conservation of fuel and power", which applies to HVAC systems in buildings, with separate parts for new buildings (L1 for residential, L2 for commercial) and existing buildings (L1 and L2). The text states that Part L sets out energy performance standards to minimize environmental impact and outlines how to demonstrate compliance. It then lists five key aspects covered by these regulations: 1. Control of heating, 2. Insulation of pipes and ducts, 3. Efficient operation, 4. Energy metering, and 5. Commissioning.

 In the UK, the regulatory standards that govern the design and installation of HVAC systems in commercial buildings are encapsulated in the Building Regulations, which are statutory instruments that seek to ensure that the policies set out in relevant legislation are carried out.

Part L of the Building Regulations, titled "Conservation of fuel and power", directly applies to HVAC systems in buildings. There are separate parts to Part L for new buildings (L1 for residential, L2 for commercial) and existing buildings (again L1 and L2, depending on the type). The document sets out energy performance standards for buildings to minimize the environmental impact and outlines how to demonstrate that HVAC installations are compliant.

These regulations cover aspects like:

1. **Control of heating:** Each space or zone in a building should have individual temperature control. The systems should also be programmed based on time-of-use to prevent wasteful heating or cooling.
2. **Insulation of pipes and ducts:** The regulations specify requirements for insulating pipes and ducts to reduce heat loss.
3. **Efficient operation:** The HVAC system must operate efficiently under partial load conditions because systems often operate under partial load.
4. **Energy metering:** Buildings with a total installed power input of over 50 kW must have energy metering in place for the HVAC systems.
5. **Commissioning:** New systems should be commissioned by testing and adjusting as necessary to ensure that they use no more fuel and power than is reasonable in the circumstances.

## 5.2 AI-Assisted HVAC and Ventilation Calculations

The engineers used ChatGPT to help them to correctly write in English, to use adequate standards, select materials and equipment, and perform calculations related to the HVAC and ventilation system design. ChatGPT provided valuable data and insights, including:

1. **Load estimation:** ChatGPT helped the engineers to estimate heating and cooling loads more accurately by considering factors such as the building's insulation, orientation, and occupancy patterns.
2. **Duct sizing and layout:** ChatGPT provided guidance on optimal duct sizing and layout to ensure proper airflow and minimize energy losses. This resulted in a more efficient distribution of conditioned air throughout the store.
3. **Equipment selection:** ChatGPT assisted the engineers in choosing the most energy-efficient HVAC equipment, such as air handling units and heat recovery systems, in compliance with British standards (CIBSE, 2016).
4. **Ventilation requirements:** ChatGPT helped the engineers to calculate the minimum ventilation rates necessary to maintain good indoor air quality and comply with British standards.

**Figure 2. Example of assistance in material selection. Answer by ChatGPT-4.**

What is the difference between these two insulation commercial materials: Climaver A2 y Climaver A2 Apta?

Climaver A2 and Climaver A2 Apta are both insulation materials used in the building industry. The primary difference between them lies in their fire performance classification. Climaver A2 has a fire performance classification of A2-s1,d0, which indicates it is a non-combustible material with low smoke emission and no flaming droplets. On the other hand, Climaver A2 Apta has a fire performance classification of B-s1,d0, signifying that it is a material with limited combustibility, low smoke emission, and no flaming droplets.

In summary, the difference between Climaver A2 and Climaver A2 Apta is their fire performance classification, with Climaver A2 being non-combustible and Climaver A2 Apta having limited combustibility.

**Figure 3. Example of assistance in equipment selection. Answer by ChatGPT-3.5.**

Can you provide me with the cooling/heating powers, weights, COP, EER, and dimensions of the FDC560KXE6 and FDCA140HKXEN4A units from MITSUBISHI in tabular format?

Sure! Here's the table with the cooling/heating powers, weights, COP, EER, and dimensions of the FDC560KXE6 and FDCA140HKXEN4A units from MITSUBISHI:

Model	Cooling Power (kW)	Heating Power (kW)	Weight (kg)	COP (Cooling)	COP (Heating)	EER (Cooling)	Dimensions (mm)
FDC560KXE6	56.0	63.0	616	3.71	4.07	3.16	2150×1100×2180
FDCA140HKXEN4A	14.0	16.0	135	3.84	4.33	3.41	1050×400×1400

I apologize for the missing information in the table. Unfortunately, I don't have access to the specific data for these models. It's best to consult the official Mitsubishi product documentation or contact a Mitsubishi representative for accurate and up-to-date information regarding the cooling/heating powers, weights, COP, EER, and dimensions of these units.

By leveraging AI-driven assistance from ChatGPT, the engineers were able to optimize the HVAC and ventilation system design more quickly and accurately, resulting in a more efficient and comfortable shopping environment.

### 5.3 Real-Time Monitoring and Control

Once the HVAC and ventilation installations were implemented, the engineers integrated an AI-driven Building Management System (BMS) to monitor and control the systems in real-time. The BMS collected data from sensors throughout the store, tracking variables such as

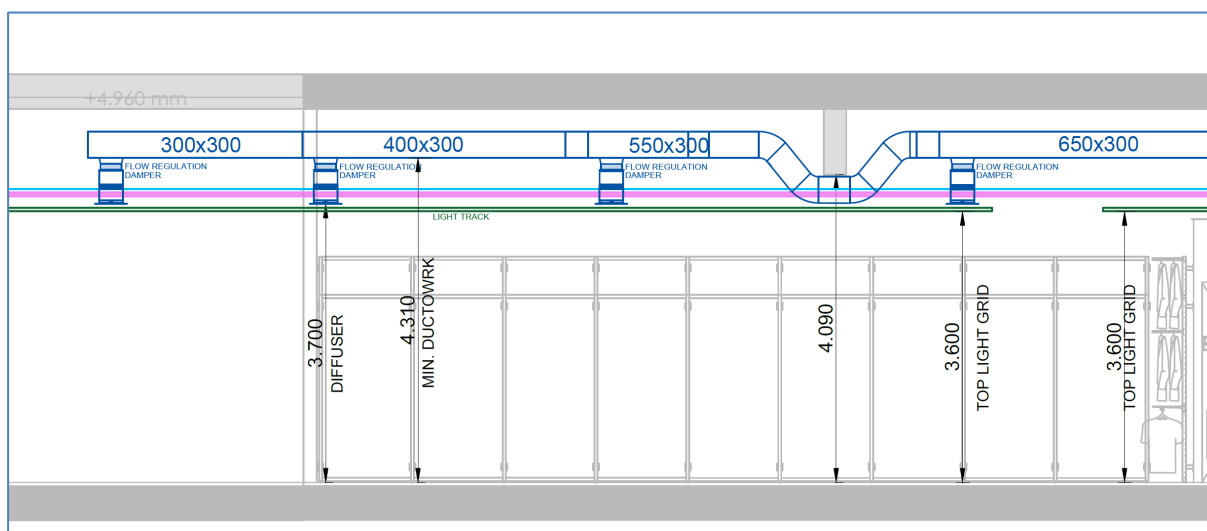


temperature, humidity, occupancy levels, and air quality (Balaji & Agarwal, 2018). AI algorithms were used to analyze this data and make adjustments to the operation of the installations, ensuring optimal performance and energy efficiency (Jain et al., 2012).

## 5.4 Results

The AI-driven approach to designing and optimizing the HVAC and ventilation installations proved successful. By leveraging AI tools like ChatGPT, the engineers were able to have a quick assistance in materials and equipment, streamline some calculations and ensure compliance with British standards (ASHRAE, 2019).

**Figure 1. Ducts for air conditioned. Source: own elaboration**



This case study demonstrates the potential of AI tools to assist industrial engineers in the design and optimization of building installations, such as HVAC and ventilation systems (Makhelouf & Maalouf, 2020). By leveraging AI-driven techniques, engineers can create more efficient, sustainable, and cost-effective solutions that adhere to industry standards, benefiting both their clients and the environment.

AI tools, such as ChatGPT, can provide several key improvements and information during the design process of HVAC and ventilation installations, benefiting engineers in multiple ways:

1. **Data-driven design:** AI tools can process large amounts of data from multiple sources, such as climate data, historical energy usage, and occupancy patterns. This information helps engineers make more informed decisions and design HVAC and ventilation systems tailored to the specific needs of a building.
2. **Parametric optimization:** AI tools can efficiently explore a wide range of design parameters and identify optimal solutions. For instance, by running simulations with varying duct sizes, equipment capacities, and control strategies, AI can find the most energy-efficient and cost-effective design that meets performance requirements.
3. **Faster design iterations:** AI tools can rapidly perform complex calculations and generate results, significantly reducing the time it takes to iterate and refine the design. This enables engineers to explore more design options and arrive at a better solution in less time.
4. **Predictive performance analysis:** AI tools can use machine learning algorithms to predict the performance of HVAC and ventilation systems under various conditions.

This allows engineers to test different design scenarios and proactively identify potential issues, such as insufficient cooling capacity or poor air distribution.

5. Compliance and code checking: AI tools can be trained to understand and apply relevant building codes and standards. This helps engineers ensure their designs are compliant and reduces the risk of errors or omissions that may lead to costly revisions or penalties.
6. Automated documentation: AI tools can generate detailed design documentation, such as schematics, schedules, and reports, with greater accuracy and efficiency. This reduces the time spent on manual documentation tasks and minimizes the risk of errors.
7. Enhanced collaboration: AI tools can facilitate better communication and collaboration among project stakeholders by providing real-time access to design information and facilitating information sharing between team members.

In summary, AI tools like ChatGPT can help engineers in various aspects of the design process by providing data-driven insights, optimizing design parameters, accelerating iterations, predicting performance, ensuring compliance, automating documentation, and enhancing collaboration. These improvements lead to more efficient, sustainable, and cost-effective HVAC and ventilation installations that meet the specific needs of a building and adhere to industry standards. However, all data provided must be previously checked and should not be taken as true. There are usually some mistakes in the information given by this AI.

## 6. Conclusions

The integration of AI tools, such as ChatGPT, into the engineering field, particularly in the design and optimization of building installations, offers numerous benefits. This article has explored the various ways AI can assist engineers in their work. One example has been the design and development of HVAC and ventilation installations in the context of a clothing store in the UK. AI-driven techniques can streamline calculations, ensure compliance with standards, enhance efficiency, and improve the overall design process. The case study demonstrated the potential of AI tools to assist industrial engineers in achieving energy-efficient, cost-effective, and sustainable design solutions that adhere to industry standards. Real-time monitoring and control, enabled by AI-powered building management systems, also ensure the continuous optimization of installations, providing a comfortable and safe environment for occupants.

As AI continues to evolve and develop, its potential applications in the engineering field will only expand, offering more opportunities for professionals to leverage these tools to improve their work and create better solutions for their clients.

It is still soon to forecast the impact that these AI tools will have in employment (Mok and Zinkula, 2023). Although a University of Oxford study conducted in 2013 had projected that AI could replace 47% of jobs in the US within the next two decades, this prediction seems to have missed the mark (Frey & Osborne, 2013). However, a recent study by Goldman Sachs revealed that generative AI tools, such as ChatGPT, have the potential to affect around 300 million full-time jobs globally, which could cause significant disruption in the job market. How this will impact on engineering employment will depend on the quick adoption of these new tools as a way to improve the quality and efficiency of the engineer's work (Manyika et al., 2017).

Chat GPT have the potential to revolutionize the way engineers work, helping them to solve complex problems faster and more efficiently than ever before. Additionally, it's crucial to remember that Chat GPT is not a replacement for human expertise and knowledge. Engineers

should use it as a supplement to their own experience and expertise, rather than relying solely on the AI system to provide solutions to complex problems.

This tool still has some areas for improvement. It was necessary for us to cross-check the information as it occasionally presented errors. For instance, when we requested a table featuring the characteristics of the machines used in the presented case study, we found some of the data to be incorrect, even though most of it was accurate. Similarly, when posing queries about formulas, we needed to have a clear understanding of the formula we were seeking, refining our search with different questions; ultimately, however, it did yield accurate information. Our inquiries also encompassed common materials in the UK for air conditioning and the naming conventions for wiring, and we encountered both mistakes and successes in these areas.

In summary, ChatGPT offers a range of capabilities that can help engineers in their work. Whether it's processing large amounts of text data, solving complex problems, predicting future trends, serving as a virtual assistant, or managing knowledge, ChatGPT has the potential to enhance the work of engineers and improve overall productivity.

## 7. References

- Abadi, M., Barham, P., Chen, J., Chen, Z., Davis, A., Dean, J., ... & Kudlur, M. (2016). TensorFlow: A system for large-scale machine learning. In 12th USENIX Symposium on Operating Systems Design and Implementation (OSDI 16), pp. 265-283.
- ASHRAE Handbook—HVAC Applications (2019). American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
- Balaji, B., & Agarwal, Y. (2018). Building automation systems: A review of data-driven techniques. *Energy and Buildings*, 173, 67-79.
- British Standards Institution. (2017). BS EN 16798-3:2017: Energy performance of buildings. Ventilation for buildings. British Standards Institution.
- Bughin, J., Hazan, E., Ramaswamy, S., Chui, M., Allas, T., Dahlström, P., ... & Trench, M. (2017). Artificial Intelligence: The Next Digital Frontier? McKinsey Global Institute.
- CIBSE Guide B: Heating, Ventilating, Air Conditioning, and Refrigeration (2016). Chartered Institution of Building Services Engineers.
- Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2018). BERT: Pre-training of deep bidirectional transformers for language understanding. arXiv preprint arXiv:1810.04805.
- Frey, C. B., & Osborne, M. A. (2013). The Future of Employment: How Susceptible Are Jobs to Computerisation? University of Oxford.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
- Jain, R. K., Taylor, J. E., & Peschiera, G. (2012). Assessing eco-feedback interface usage and design to drive energy efficiency in buildings. *Energy and Buildings*, 48, 8-17.
- Makhelouf, A., & Maalouf, C. (2020). A review on the use of artificial intelligence for energy-efficient and cost-effective HVAC systems in buildings. *Renewable and Sustainable Energy Reviews*, 119, 109581.
- Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). Harnessing Automation for a Future That Works. McKinsey Global Institute.

Mok, A. and Zinkula, J. (2023). ChatGPT may be coming for our jobs. Here are the 10 roles that AI is most likely to replace. The Business Insider, Apr 9, 2023.

Morosan, C. (2016). The Role of Artificial Intelligence in Decision-Making. Procedia Computer Science, 91, 1036-1042.

Schwab, K. (2017). The Fourth Industrial Revolution. Crown Business.

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., ... & Polosukhin, I. (2017). Attention is All You Need. Advances in Neural Information Processing Systems, 5998-6008.

Xu, A., Liu, Z., Guo, Y., Sinha, V., & Akkiraju, R. (2017). A new chatbot for customer service on social media. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, pp. 350-359.

### **Communication aligned with the Sustainable Development Objectives**

